NON-PUBLIC?: N
ACCESSION #: 8712230093

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Arkansas Nuclear One, Unit Two PAGE: 1 of 5

DOCKET NUMBER: 05000368

TITLE: Reactor Trip on High Reactor Coolant System Pressure Due to Main Turbine Trip Caused by Inaccurate Bearing Vibration Indication and Incorrect Turbine Trip Setpoint
EVENT DATE: 11/14/87 LER #: 87-008-00 REPORT DATE: 12/11/87

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT: On 11/14/87 with the unit operating at full power, indicated high bearing vibrations on number nine main turbine generator journal bearing initiated an automatic trip of the main turbine. The resulting primary to secondary power mismatch caused an automatic reactor trip on high reactor coolant system pressure within a few seconds of the main turbine trip. Emergency feedwater automatically activated as designed to restore and maintain steam generator water levels. The main turbine trip was due to the trip setpoint for number nine bearing high vibration being set at a value lower than specified in plant procedures in combination with inaccurate indications of number nine bearing vibration provided to the trip system (high bearing vibration was not shown using local vibration monitoring equipment). Documentation could not be found to show that the vibration monitoring instruments and portions of the main turbine trip system utilizing these instruments had been routinely calibrated. The number nine bearing high vibration trip setpoint was increased to the correct value and a routine calibration program for the vibration monitoring system is being developed. On 11/15/87, the main turbine generator was started and loaded. Vibration indication at the number nine bearing had returned to an acceptable level consistent with locally measured pre-trip values.

(End of Abstract)

I. Description of Event

A. Unit Status

Arkansas Nuclear One, Unit Two (ANO-2) was operating at 100 percent power with a reactor coolant system (RCS) average temperature of 580 degrees Fahrenheit and pressurizer pressure of 2250 psia.

B. Component Identification

The ANO-2 main turbine (EIIS Identifier = TA-TRB-G084) is a tandem compound unit consisting of three separate turbines, a high pressure (HP) section and two low (LP) sections (see Figure 1). The main generator (EIIS Identifier = TB-GEN-G084) is coupled directly to the rotor of the "B" LP turbine. The field of the main generator is supplied by an AC synchronous exciter generator (EIIS Identifier = TB-EXC-G084) which is coupled directly to and driven from the main generator. The rotors of the turbines, main generator and alternator exciter are supported by ten journal bearings. This event involved indications of high bearing vibrations associated with the number nine bearing used to support the main generator end of the exciter rotor.

C. Sequence of Events

On 11/14/87 at 0530 hours the main turbine generator automatically tripped due to indication of high vibrations associated with the main turbine generator number nine journal bearing. Approximately four seconds later an automatic reactor trip on high RCS pressure occurred. Operations personnel responded to the reactor trip by performing the immediate actions of the emergency operating procedure. The emergency feedwater system (EFW) actuated automatically on normal post trip steam generator (SG) low water level response with both EFW pumps starting and supplying feedwater to the SGs. The "B" main feedwater pump tripped as designed upon actuation of the main turbine trip. The "A" main feedwater pump and the EFW system were used to restore SG water levels to normal. At 0542 hours the steam driven EFW pump was secured. At 0612 hours the "A" MFW pump was secured and SG water level control was maintained utilizing the electric motor driven EFW pump. Other plant systems responded normally to the trip and the plant was stabilized in hot standby (Mode 3). Investigations were initiated to determine and correct the cause of the main turbine trip.

Maintenance was performed on the number nine bearing, the coupling between the main generator and exciter rotors, and the turbine supervisory instrumentation system. Following reactor startup on 11/15/87 the main turbine was started and loaded. Vibration indications on the number nine bearing had returned to an acceptable level and the unit was returned to full power operation.

II. Event Cause

A. Event Analysis

The ANO-2 turbine generator system is equipped with a supervisory instrumentation system which utilizes detectors to monitor a number of variable parameters on the system components. Each of the main bearings of the turbine, generator, and generator exciter are equipped with velocity type vibration detectors used to measure vibratory motion of the rotors of these components. The detectors produce an output which is displayed and recorded in the control room and is also used to provide an audible control room alarm upon detection of high vibration from any bearing. In addition, to provide protection for components from excessive shaft vibration the detector outputs are used in the main turbine trip system and will generate a turbine trip signal if any bearing vibration exceeds a specified trip setpoint.

During the previous few weeks prior to this event, operations personnel had observed that the control room indication of vibration on the number nine bearing was erratic. The indication was periodically increasing and then immediately decreasing i.e., spiking, for no apparent reason. Local vibration measurements taken on the bearing housing using a portable vibration detector indicated vibrations significantly lower than the control room indications. The local readings did not indicate vibration levels that were excessively abnormal. Investigations into the cause of the disparity between the vibration indications was in progress at the time of the turbine trip on 11/14/87.

On 11/14/87 at 0127 hours, the main turbine high vibration control room alarm actuated momentarily and then cleared. Control room operations personnel noted that the number nine bearing indicated a vibration level of approximately 9.5 mils. Shaft vibrations taken locally again showed that the control room indication of bearing vibration was high when compared to the local

measurements. Actions were initiated to obtain vibration readings using a more sophisticated vibration measurement instrument. During the next few hours the control room alarm actuated and immediately cleared several times. At 0530 hours vibration on the number nine bearing increased to a level sufficient to actuate the main turbine trip system resulting in an automatic turbine generator trip. This produced a large power mismatch between reactor power and turbine power causing RCS pressure to increase rapidly to the Reactor Protection System high RCS pressure trip setpoint of approximately 2362 psia.

The main turbine trip on high bearing vibration was initiated when vibration on the number nine bearing increased to an indicated value of approximately ten mils. Instructions contained in plant procedures stated that a high vibration trip would not occur until vibration reached a level of approximately twelve mils. This led operations personnel to believe there was significant margin between the indicated bearing vibration and the trip setpoint.

Following the turbine trip, maintenance personnel performed a calibration check of the turbine supervisory instrumentation system. These checks revealed that the system was calibrated to produce a main turbine high vibration trip at approximately ten mils on the number nine bearing instead of the specified twelve mils. Additionally, some components of the system required calibration adjustments. During the course of investigations no documentation could be located to indicate that the vibration instruments or the portion of the turbine trip system utilizing inputs from these detectors had been routinely calibrated.

Following completion of maintenance activities performed as a result of the trip, the main turbine was started and loaded on 11/15/87. Local readings on the number nine bearing indicated vibration levels approximately the same as those obtained prior to the trip. The control room vibration indication also agreed more closely with local measurements indicating that calibrations performed on the system had improved the correlation of these readings.

Based on an evaluation of overall system response to the transient, the safety significance of this event was concluded to be minimal. Operations personnel were able to stabilize the plant in a hot standby condition within a few minutes after the reactor trip.

B. Root Cause

The main turbine trip and subsequent reactor trip were caused by the trip setpoint for high bearing vibration being set at a value lower than specified in plant procedures. A significant contributing factor was the inaccurate indication of bearing vibration provided to the trip system and used for control room indication. The reasons for the trip setpoint being set below the specified value and the vibration indication problems were not conclusively determined.

C. Basis for Reportability

This event resulted in an unplanned automatic actuation of the Reactor Protection System and Emergency Feedwater System and is therefore reportable per the provisions of 10CFR50.73(A)(2)(iv). This event was reported per 10CFR50.72(B)(2)(ii) at 0600 hours on 11/14/87.

III. Corrective Action

A. Immediate

Immediate actions consisted of operations personnel performing the immediate actions of the emergency operating procedure and placing the unit in a stable hot standby condition.

B. Subsequent

The number nine bearing was removed and replaced with a new bearing. The coupling used to connect the main generator and exciter rotors was disassembled and inspected. The coupling

was found to be adequately lubricated. Inspection of the coupling internal components indicated some wear. This was discussed with the turbine generator manufacturer, GE, and determined not to be of immediate concern. The rotors of the two components were realigned and the coupling reassembled.

Further investigation into the problem of control room bearing vibration has revealed a potential concern related to the mounting used for the installed vibration detectors. This concern is still being evaluated.

Maintenance personnel recalibrated the turbine supervisory

instrumentation system to increase the turbine trip setpoint on high bearing vibration to a value of twelve mils. This is in accordance with the turbine manufacturer's recommended setpoint for this parameter. Additionally, components of the vibration sensing and indication circuit were checked and recalibrated as necessary.

C. Future

A maintenance procedure for calibrating the turbine supervisory instrumentation has been developed. It is anticipated that this procedure will be scheduled and performed routinely during refueling outages to verify the trip setpoints for high bearing vibrations are correct and components of the system are within specified tolerances.

Consultation with the turbine generator vendor is continuing to determine if other actions are warranted as a result of this event. Although not directly related to the root cause of this event, some modifications are being evaluated for future implementation. These include changing the type of coupling used between the main generator and exciter and different alignment specifications for the rotors of these components.

IV. Similar Occurrences

There have been no similar occurrences reported at ANO-2.

FIGURE 1 - MAIN TURBINE
FIGURE OMITTED - NOT KEYABLE (DRAWING)

ARKANSAS POWER & LIGHT COMPANY
December 11, 1987

2CAN128702

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

SUBJECT: Arkansas Nuclear One - Unit 2
Docket No. 50-368

License No. NPF-6
Licensee Event Report No. 368/87-008-00

Gentlemen:

In accordance with 10CFR50.73(a)(2)(iv), attached is the subject report concerning a reactor trip on high reactor coolant system pressure due to main turbine trip caused by inaccurate bearing vibration indication and incorrect turbine trip setpoint.

Sincerely,

/s/ J. M. Levine
J. M. Levine
Executive Director,
ANO Site Operations

JML:DJM:dm
attachment

cc w/att: Regional Administrator
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